Line Haul Tug M/V Pacific Falcon Low-NOx Repower Project

Prepared for: BHP Billiton Cabrillo Port Offshore LNG Terminal

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M/V PACIFIC FALCON REPOWER PROJECT

Background

BHP Billiton LNG International, Inc. (BHP) is proposing to build a LNG importation terminal located in Federal waters approximately 14 miles off the Coast of Ventura County. The terminal consists of a Floating Storage and Regasification Unit (FSRU) which is used to store and vaporize liquefied natural gas (LNG). LNG delivered from LNG carriers is offloaded to the FSRU, stored until needed and then regasified. Gas is then transported via two parallel 24-inch pipelines to an onshore facility at Ormand Beach near Oxnard in Ventura County. The project location is 2.06 nautical miles from the edge of shipping channel.

BHP has offered to mitigate the proposed project's NOx emissions by funding engine conversions for third party marine vessels operated along the California Coast. This report identifies one of these vessels, the M/V Pacific Falcon, and documents the anticipated emission reductions as a result of the engine repowering as well as the areas where the anticipated emission reductions are expected to occur.

Proposed Mitigation Project

Project

Repower the line haul tug boat M/V Pacific Falcon operated by Olympic Tug & Barge, Inc. with low-NOx engines for use in the hauling of the barge Jovalan.

M/V Pacific Falcon Details

M/V Pacific Falcon details are as follows:

Length 121.1'
Yr. Built 1967
Official Number 507257

M/V Pacific Falcon Baseline (i.e., Existing) Engines

The M/V Pacific Falcon utilizes two engines for propulsion. Both are Electro-Motive Diesel (EMD) 16-645E engines which generate 1,950 h.p. at 900 rpm. Pacific Falcon is currently being utilized in the line haul service elsewhere but will go into service replacing several other tugs hauling the petroleum barge Jovalan mid-2006.

The M/V Pacific Falcon existing engines are as follows:

Port 16-645E2, 1950 h.p. @ 900 rpm, MY 1966, S/N 66K1-1072
Starboard 16-645E2, 1950 h.p. @ 900 rpm, MY 1966, S/N 66L1-1015

Project Description

Olympic Tug and Barge has utilized tugs Millennium Dawn, Millennium Star, Eagle, and CF Campbell during the baseline period March 1, 2005 through Feb 28, 2006 for the towing of petroleum barge Jovalan. Prior to being contacted by BHP, Olympic Tug and Barge decided to dedicate the tug Pacific Falcon to the hauling of the barge Jovalan commencing in mid-2006. Jovalan barge picks up crude oil from Platform Ellwood (near UCSB in Santa Barbara) and delivers it to various destinations along the California coast. Olympic Tug & Barge operates the tugs under contract whereby the oil company pays for all fuel used in the run. As a result, careful fuel records are maintained based on fuel tank measurements before and after each trip.

The fleet utilized over the baseline period (March 1, 2005 through Feb 28, 2006) for barge Jovalan consists of:

- CF Campbell: Model Cat 3516B, S/N 8KN00073, 8KN00074, Rating 2000 h.p., Model Year (MY) 1995
- Eagle: Model Cat 3512B, S/N 4TN00037, 4TN00038, Rating 1,500 h.p., MY 1995
- Millennium Star: Cat 3516B, S/N 8KN00407, 8KN00406, Rating 2,200 h.p., MY 2000
- Millennium Dawn: Cat 3516B, S/N 000454, 8KN00453, Rating 2,200 h.p., MY 2001

Attachment E includes a summary of engines and tug details.

The Pacific Falcon engines are almost 40 years old with a NOx baseline emissions factor of 15.2 gms/bhp-hr. Although the Pacific Falcon was not used to transport the barge Jovalan in the baseline period, it will haul the barge during the year leading up to the engine repower (2007). Therefore, OceanAir believes that it would be appropriate to utilize the Pacific Falcon's NOx baseline emissions factor in calculating the emission reductions attributable to the repower. However, in order to be conservative, OceanAir is using a NOx baseline emissions factor based on the tugs that have hauled the barge Jovalan during the March 1, 2005 through February 28, 2006 period. The NOx baseline emissions factor was derived using the NOx emissions attributable to each tug and weighted according to fuel use during the baseline period.

Engine Repower

The engine repower project consists of replacing M/V Pacific Falcon's existing diesel propulsion engines (dual EMD12-645E2 engines) with new low-emissions EMD8-710G7B diesel propulsion engines. The 8-710G7B engines are rated at 2,000 h.p. each at 900 rpm. 8-710G7B engines are electronically controlled while the 12-645E2 engines are mechanically controlled. The electronic controls ensure more precise operation and lower emissions per brake horsepower-hour (bhp-hr). Additionally 8-710G7B engines are more fuel efficient compared to the existing 12-645E2 engines.

Emission Reduction Calculations and Documentation

a. Historical Operation

Fuel and trip logs for each of the tug boats that serviced barge Jovalan for the twelve months period of March 1, 2005 through February 28, 2006 were reviewed. The fuel logs document that in the12 month baseline period a total of 503,966 gallons of diesel was burned in the tugs while hauling the barge Jovalan. A summary of the fuel logs is presented in Section A of Attachment A. A fuel use worksheet and copies of the vessels' daily logs (reflecting fuel use) are included in Attachment C. As noted above, fuel usage was determined by tank soundings before and after each trip.

The trip logs document that the barge Jovalan and its associated tugs took a total of 118 trips. Of this total, 65 were line haul trips (inter-coastal), 29 trips occurred locally within the Los Angeles, El Segundo and Long Beach area, and 24 trips occurred locally within the Richmond, San Francisco, Martinez, Benicia, Avon, and Rodeo area. A summary of trip logs is presented in Section B of Attachment A.

b. Emission Reduction Calculation Formula

In order to calculate the emission reductions attributable to the M/V Pacific Falcon engine repower, OceanAir utilized the equation memorialized in South Coast AQMD Rule 1631(f). Rule 1631 established a program for the generation of mobile source emission reduction credits (MSERCs) through the repowering of diesel-fueled marine

vessels. This rule was the subject of prolonged discussion between US EPA Region 9, South Coast AQMD and various stakeholders. This effort generated a rule that took into account multiple perspectives while ensuring a reasonably conservative means of MSERC calculation. This rule has been approved by EPA as part of the California State Implementation Plan. As a result, Rule 1631 is uniquely appropriate for the calculation of the anticipated emission reductions attributable to this marine engine repower project.

Consistent with Rule 1631, the emission reductions attributable to the repowering of M/V Pacific Falcon were quantified using the following equation:

$ER_{Pacific\ Falcon} = (EF_{base}-EF_{repower}) \times ECF \times Fuel\ Burn /454/2000$

Where:

EF_{base} = Baseline Emission Factor (gms/bhp-hr)

$EF_{repower}$ = Repower Emission Factor (gms/bhp-hr)

ECF = Energy Consumption Factor (bhp-hr/gal)

The basis for each of these variables is explained below.

c. Baseline Emission Factor (EF_{base})

The baseline emission factors for NOx was taken from the emissions data base file stored in Caterpillar computers for the specific serial and model numbers. A copy of the data base printout reflecting the emission rate is included as Attachment B; the relevant entry is hand marked with an arrow.

d. Repower Emission Factor ($EF_{repower}$)

The repower emission factors were based on the Tier 2 emission limits. As documentation of compliance with these limits, OceanAir has included as Attachment D EMD's Certificate of Conformity.

e. Energy Consumption Factor (ECF)

The Energy Consumption Factor was derived from information in the EPA 2006 Model Year Certificate of Conformity. Specifically, the brake specific fuel consumption (bsfc) is identified in the Certificate of Conformity Propeller Cube Curve as 0.314 lb/bhp-hr at 900 rpm. At a fuel density of 7.1 lb/gallon, the ECF calculates to 22.61 bhp-hr/gal.

f. Emission Reduction Calculations

Based on the formula and variables identified above, OceanAir calculated the emission reductions anticipated to result from the repowering of the M/V Pacific Falcon. Details for this calculation are shown in Section C of Attachment A. In total, it is projected that as a result of the M/V Pacific Falcon engine repower project NOx emissions in California

Coastal Waters will be reduced by 72.79 tons per year. Emission reductions by segment and by air district are presented in Sections C.4 and C.5 of Attachment A.